

Chapter 06

Structure of atom

Quantum Mechanical Model:

Electrons are invisible to our naked eye.

Ex:

A pen, book or anything. You take a torch at night, especially you take a torch and search for your item of interest. Similarly, to find an electron in an atom, we take the help of suitable light to find the position and velocity of the electron.

As the electrons are very small, light of very short wavelength is required for this task.

This short wavelength light interacts with the electron disturbs the motion of electron. Hence simultaneously the position and velocity of electron cannot be measured accurately.

To understand properties of electron in an atom, a **Quantum Mechanical Model** of atom was developed by Professor Erwin Schrodinger.

According to **Schrodinger's model**, electrons are thought to exist in particular region rather than in a line. Electrons are thought to exist in a particular region of space around the nucleus at a given instant of time. The region of space around the nucleus where probability of finding the electron is maximum is called an orbital. Remember I'm saying it the probability of finding an electron.

Each orbital of a stable energy state for the electron is described by particular set of quantum numbers. We use these quantum numbers to discuss about the 3D picture. With the help of all these quantum numbers, we can get an idea of the position or the probability of finding an electron in that particular region.

Quantum numbers:

Each electron in an atom is described by a set of three numbers n , l & m_l . These numbers are called quantum numbers. These numbers indicate the probability of finding electron in the space around the nucleus.

The first quantum number called as Principal quantum number, is related to the size and energy of main shell and is denoted by n . It has positive integer values $1, 2, 3, \dots$.

As ' n ' increases the shell becomes larger and larger and electron in those shells are further away from the nucleus and also as ' n ' increases and also energy increases.

Example:

$n = 1$, $n = 2$ & $n = 3$, they are often represented by the letters k , l , m & n .

$n = 1$, called as k shell, $n = 2$ (l shell) and $n = 3$ (m shell).

Angular Momentum Quantum Number:

The angular momentum quantum number is represented by l .

' l ' has integer values from 0 to $n - 1$,

Example:

If $n = 2$, l ranges from 0 to $n - 1$ which is 1 . So, l has the values 0 & 1 for $n = 2$.

If $n = 3$, l ranges from 0 to 2 . Each value of l is related to shape of a particular subshell in the space around the nucleus. Each shell has some subshells.

The value of l for any particular subshell is designated by the letters s , p , d , f .

For $l = 0$ the subshell is ' s '.

For $l = 1$ the subshell is ' p '.

For $l = 2$ the subshell is 'd'.

For $l = 3$ the subshell is 'f'.

Magnetic quantum number, which represents ' m_l ' and has integer values between $-l$ to $+l$ including '0'.

Example:

When I say $n = 2$ the values of l are 0 and 1. What about the magnetic quantum number for any particular l value. For a certain value of l there are $2l+1$ integer values of m_l .

Example:

$l = 0$, which is a subshell 's'. $2l + 1 = 1$. So, magnetic quantum number ' m_l ' is '0' for $l = 0$. Thus we have only one orbital '1s'.

$l = 1$, $2l + 1 = 3$ which means that there are three values - 1, 0 and +1 or 3p orbitals with different orientations which are labeled as p_x which is along the x - axis, p_y which is along y - axis, p_z which is along the z - axis.

